

CLAIMS

1. An endoscope inserting direction detecting apparatus comprising:

image input means for receiving an endoscopic image from an endoscope that is inserted into a body cavity;

pixel sampling means for sampling a stated pixel value from the endoscopic image received by the image input means;

shape estimating means for estimating the shape of a specified area on the basis of the continuity of the distribution of pixels that indicate the stated pixel value and that are sampled by the pixel sampling means; and

inserting direction determining means for determining an inserting direction within the body cavity, in which the endoscope should be further inserted, according to the shape estimated by the range shape estimating means.

2. An endoscope inserting direction detecting apparatus according to Claim 1, wherein the pixel sampling means samples pixels that represent a halation which is caused by specular reflection in the body cavity or pixels that represent the edge of a fold on an inner wall of the body cavity.

3. An endoscope inserting direction detecting system comprising:

endoscopic image domain dividing means for dividing an endoscopic image, which is imaged and produced by an

endoscope inserted into a body cavity, into a plurality of domains;

pixel sampling means for comparing the values of pixels constituting each of the domains, into which the endoscopic image domain dividing means divides the endoscopic image, with a threshold, and for sampling the distribution of pixels whose values are equal to or larger than the threshold;

suitability-for-lumen position defining means for defining domains representing suitability for a lumen position;

direction-of-lumen estimating means for defining a plurality of circles, which have different radii, over the domains representing suitability for a lumen and being defined by the suitability-for-lumen position defining means and the domains of the endoscopic image, and for estimating the direction of a lumen from the distribution of pixels which are sampled by the pixel sampling means because the values thereof are equal to or larger than the threshold and which are placed between the plurality of circles;

inserting direction determining means for determining an endoscope inserting direction over the domains, which represent suitability for a lumen position, on the basis of the direction of a lumen estimated by the direction-of-lumen estimating means; and

inserting direction display means on which an inserting direction is displayed together with the endoscopic image on the basis of the endoscope inserting direction determined by the inserting direction determining means.

4. An endoscope inserting direction detecting system according to Claim 3, wherein the pixel sampling means samples pixels that represent a halation caused by specular reflection in the body cavity or pixels that represent the edge of a fold on the inner wall of the body cavity.

5. An endoscope inserting direction detecting system according to Claim 3, wherein the direction-of-lumen estimating means estimates the direction of a lumen, which is useful in determining an inserting direction, from a difference in an angle between a vector whose initial point lies at the position of a center of balance in the distribution of pixels sampled by the pixel sampling means and whose terminal point lies at the position of the center of a domain representing suitability for a lumen position out of all the domains defined by the suitability-for-lumen position defining means, and a vector orthogonal to a regression line expressing the distribution of pixels.

6. An endoscope inserting direction detecting system according to Claim 3, wherein the direction-of-lumen estimating means calculates a gradient vector that expresses each of pixels representing the edge of a fold and being

sampled by the pixel sampling means, and estimates the direction of a lumen from the distribution of pixels that are expressed with gradient vectors having the same direction and that represent the edge.

7. An endoscope inserting direction detecting system according to Claim 3, wherein the centers of the plurality of circles having different radii and extending over the domains, which represent suitability for a lumen position and are defined by the suitability-for-lumen position defining means, and the domains of the endoscopic image are located in the same domain representing suitability for a lumen position.

8. An endoscope inserting direction detecting system according to Claim 3, wherein the direction of a lumen estimated from the distribution of pixels, of which values are equal to or larger than the threshold and which are placed between the plurality of circles having different radii, by the direction-of-lumen estimating means corresponds to the direction of the position at which the centers of the plurality of circles lie.

9. An endoscope inserting direction detecting method, comprising:

image input means for receiving an endoscopic image;  
pixel sampling means for sampling pixels, which indicate a high pixel value, from the endoscopic image

received by the image input means;

pixel selecting means for selecting pixels, which lie in a specified area, from among the pixels sampled by the pixel sampling means;

inserting direction determining means for determining an inserting direction, in which an endoscope should be inserted, on the basis of the pixels selected by the pixel selecting means and the shape of the specified area; and

display means on which the inserting direction determined by the inserting direction determining means is displayed.

10. An endoscope inserting direction detecting method according to Claim 9, wherein the specified area containing the pixels selected by the pixel selecting means is a range defined with a plurality of circles or ellipses.

11. An endoscope inserting direction detecting method comprising:

image input means for receiving an endoscopic image of the large intestine;

pixel sampling means for sampling pixels, which represent the edge of a fold on the wall of the large intestine, from the endoscopic image of the large intestine received by the image input means;

pixel selecting means for selecting pixels, which lie in a specified area, from among the pixels representing the

edge of a fold and being sampled by the pixel sampling means;

inserting direction determining means for determining an inserting direction, in which an endoscope should be inserted, on the basis of the pixels representing the edge and being selected by the pixel selecting means, and the shape of the specified area; and

display means on which the inserting direction determined by the inserting direction determining means is displayed.

12. An endoscope inserting direction detecting method according to Claim 11, wherein the specified area containing the pixels selected by the pixel selecting means is a range defined with a plurality of different circles or ellipses.

13. An endoscope inserting direction detecting method according to Claim 12, wherein the centers of the plurality of different circles or ellipses are located at the same position or in the same domain.

14. An endoscope inserting direction detecting method according to Claim 13, wherein the inserting direction determined by the inserting direction determining means is the direction of the position at which the centers of the plurality of circles or ellipses lie or the direction of the same domain.

15. An endoscope inserting direction detecting method

according to Claim 9, wherein the inserting direction determining means determines an inserting direction, in which an endoscope should be inserted, according to the correspondence between the direction of a lumen estimated from the shape of the distribution of pixels selected by the pixel selecting means and the direction of a lumen estimated from the shape of the specified area.

16. An endoscope inserting direction detecting method according to Claim 10, wherein the inserting direction determining means determines an inserting direction, in which an endoscope should be inserted, according to the correspondence between the direction of a lumen estimated from the shape of the distribution of pixels selected by the pixel selecting means and the direction of a lumen estimated from the shape of the specified area.

17. An endoscope inserting direction detecting method according to Claim 9, wherein the inserting direction determining means determines an inserting direction, in which an endoscope should be inserted, according to the shape of the distribution of pixels, which represent an edge and are oriented nearly in the same direction, out of all the pixels representing the edge and being selected by the pixel selecting means, and the shape of the specified area.

18. An endoscope inserting direction detecting method according to Claim 10, wherein the inserting direction

determining means determines an inserting direction, in which an endoscope should be inserted, according to the shape of the distribution of pixels, which represent an edge and are oriented nearly in the same direction, out of all the pixels representing the edge and being selected by the pixel selecting means, and the shape of the specified area.

19. An endoscope inserting direction detecting method according to Claim 9, wherein the inserting direction determining means determines an inserting direction, in which an endoscope should be inserted, on the basis of the correspondence between the direction of a lumen estimated from the shape of the distribution of pixels, which represent an edge and are oriented nearly in the same direction, out of all the pixels representing the edge and being selected by the pixel selecting means, and the direction of a lumen estimated from the shape of the specified area.

20. An endoscope inserting direction detecting method according to Claim 10, wherein the inserting direction determining means determines an inserting direction, in which an endoscope should be inserted, on the basis of the correspondence between the direction of a lumen estimated from the shape of the distribution of pixels, which represent an edge and are oriented nearly in the same direction, out of all the pixels representing the edge and



being selected by the pixel selecting means, and the direction of a lumen estimated from the shape of the specified area.